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THE WAR DEPARTMENT

FIGHTING VEHICLES RESEARCH & DEVELOPMENT ESTABLISHMENT

REPORT No. T.R. 57.

BELLY ATTACK BY ANTI-TANK MINES Mk 7 AGAINST CENTURION TANK TARGETS.

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FIGHTING VEHICLES RESEARCH AND DEVELOPMENT ESTABLISHMENT

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RESEARCH DIVISION

TRIALS GROUP REPORT

ON

BELLY ATTACK BY ANTI-TANK MINES MK.7

AGAINST

CENTURION TANK TARGETS (U)

AUTHOR:

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Chobham Lane,
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3rd October, 1962.

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S/RT		17	
R/FV & Spares		18–25	

ABSTRACT

This is a report of the damage assessment of belly attacks by Anti-tank Mines Mk.7 (20 lb TNT) against Centurion Tank targets arranged by the "Attack of Armour Committee", Ordnance Board Proceeding 08993 (Special) 13th April, 1962.

Two effective attacks were made, one centrally below the fighting compartment and the other centrally below the engine compartment. Damage sustained in the former instance was assessed to give 100% lost mobility and 100% lost fire power and in the latter instance 100% lost mobility and 10% loss of fire power.

CONTENTS

REPORT NO: TR.57

1. INTRODUCTION

Trials to determine the effect of Anti-Tank Mine Mk.7 belly attack against Centurion Tank targets were arranged by the Ordnance Board for D.R.E.E. Details of the trial request are given in Ordnance Board Proceedings Q8993 (Special), 13th April, 1962.

This report deals with the damage assessment carried out by F.V.R.D.E. using, as far as it could be applied to mine attack, the new method of assessment as described in Ordnance Board Memorandum No.2/62 issued as an Appendix to Proceeding No.Q8999 (Special), 24th July, 1962.

Instrumentation to determine the effects of blast and acceleration on the crew was arranged and the results will be the subject of a separate report by A.O.R.E. (C & E.P. Division).

The trials were carried out during May, 1962 at P. & E.E. Shoeburyness.

2. TARGET VEHICLES

Two Centurion Tanks Mk.3, Target Nos.2/62 and 4/62, from target vehicles previously used in the Attack of Armour Committee's trials of the 120 mm Tank Gun, were selected for the tests.

The two vehicles were non-runners as a result of damage sustained in the earlier gun trials, but the floor plates and general hull structures were sound. However, Target No.2/62 suffered some structural damage by the first mine attack made beneath the floor of the fighting compartment (Attack Ref. M1) which resulted in a low order detonation and was discounted as being an unrepresentative attack. The required attack in this position was subsequently made on Target No.4/62 and Target No.2/62 was used for the attack beneath the engine compartment (Attack Ref. M2). Due account was taken of this and the damage from the previous gun attacks when assessing damage to the vehicles after Attacks M2 and M3.

3. METHOD

3.1. The following attacks were made with Mine Mk.7 (20 lb) electrically detonated in each case with the mine buried 2 inches below ground level with approximately $1\frac{1}{2}$ inch additional soil mound:-

(a) Attack M2 against Target No.2/62. Centre of mine vertically below the longitudinal centre line of the floor plate in line with the left and right 5th road wheel centres; beneath the engine compartment.

(b) Attack M3 against Target No.4/62. Centre of mine vertically below the longitudinal centre line of the floor plate in line with the left and right 3rd road wheel centres; beneath the fighting compartment.

4. RESULTS DISCUSSION

4.1. Detailed damage assessment data are given in the Appendix.

4.2. Attack M2 - Detonation beneath the engine compartment

Severe deflection of the hull floor brought it into contact with the engine; fuel and oil tanks were ruptured and driver's control rods were rendered inoperable. These items were, therefore, damaged to the extent that either could account for 100% mobility loss. The total distorted area of the floor was 90 inches x 60 inches, the width of the floor, with a maximum permanent displacement of 7 inches. Details of the floor distortion are given in the Appendix, Sheet 7. Photographs showing the hull floor distortion and damage to interior components are given at Figures 2 - 5.

The hull floor and edge welds remained intact without fracture and the 2 inch thick hull side plates were drawn inwards to an appreciable degree in the region of the bulged area of the floor. The two large access covers in the area of the floor affected by blast were displaced downwards when the floor rebounded after having resisted the initial blast from the mine attack. A loss of fire power of 10% is due to failure of the auxiliary engine fuel supply which would result in the powered traverse system being out of action.

The wooden dummies representing the crew were not materially damaged and there did not appear to be any serious disturbance of the fighting compartment components attributable to this attack. More precise assessment in the fighting compartment was impracticable because of previous damage from A.P.D.S. shot attack and the low order detonation resulting from the discounted mine attack M1.

4.3. Attack M3 - Detonation beneath the fighting compartment

Severe deflection of the floor occurred, the total area affected being 80 inches x 60 inches, the width of the floor, with a maximum permanent displacement upwards of $4\frac{1}{2}$ inches; the floor plate was otherwise intact. Detailed measurements of the floor plate distortion are given in the Appendix, Sheet 7. This attack produced less permanent floor displacement than attack M2 probably because of substantial support by the floor stowage bins and their contents.

Although the turret traverse was jammed previously by the preceeding gun trials it was evident that the extensive displacement and damage to the floor stowage, rotary base junction, turret turntable and side supports would have prevented turret traverse by power or hand. Since also damage and distortion to the driver's control rods and linkage was sufficient to render them inoperative the overall effect is assessed at 100% loss of both mobility and fire power.

Damage to the dummy crew indicated that all the turret crew might well have been incapacitated.

Ammunition stowed in the floor bins was unfit for firing, all the cartridge cases being squashed to a varying degree. Several rounds were recovered loose in the fighting compartment having been projected out of the bins. Floor bin flaps and other components were wrenched from their hinges and fixtures; the batteries were shattered and pieces scattered over the whole compartment.

Photographs of the hull floor plate distortion and of internal components before and after mining are given at Figures 7 - 14.

5. SUMMARISED RESULTS

5.1. Attack M2. Made centrally below the engine compartment would have resulted in 100% lost mobility for any one of the following reasons:-

(a) Irreparable damage to the engine.
(b) Complete loss of fuel from damaged tanks.
(c) Damage to driver's control rods and linkage.

The fuel loss would also stop the auxiliary engine and eliminate power traverse; this is assessed at 10% loss of fire power.

5.2. Attack M3. Made centrally below the fighting compartment disrupted the turret floor stowage and turret platform and would have prevented traverse by obstruction. All driver's control would be lost due to distortion of the control rods. The combined effect of these two factors would be 100% mobility loss and 100% fire power loss.

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Report TR.57 Appendix Sheet 1

Form No. 1

ANTI-TANK TRIALS

DAMAGE ASSESSMENT DATA

(a)	(b)	(a)	(b)
1. Trial No.	Q 8993	13. Projectile azimuth	-
2. Trial location	Foulness Island	14. Projectile elevation	-
3. Date	22/5/62	15. Coded point of attack	Hull Floor
4. Round No.	M2	16. Location of strike	Centre of blast zone 2 in rt. of Long. centre line in line with 5th road wheel centres.
5. Projectile type	A/T Mine		
6. Projectile calibre	Mk.7 (20 lb)	17. Floor Plate Ground Clearance	20 in
7. Fuze No.	Static Detonation	18. Detail of Mine Laying	Buried 2 in below ground surface with additional 1½ in soil mound.
8. Charge weight	-	19.	
9. Striking velocity	-	20.	
10. Range Gun to target	-	21. Main armour thickness	17 mm Floor Plate
11. Equivalent range with F.S.C.	-	22. Main armour obliquity	0°
12. Target tank and No.	Cent.3 No.2/62	23. Overall repair time and echelon	-

24. Notes on tank condition prior to firing

(a) Main and Aux. Engines damaged by previous shot attack - non runners.
(b) Engine Compt. - cooling system pipes, Electrical Harness, water pump, cylinder block and other auxiliaries damaged previously.
(c) Rotary Base Junction and turret floor ammunition stowage damage by previous attack, M.1.
(d) Weighted and instrumented dummies in Gunner's and Commander's positions - Driver and Loader represented by unweighted dummies.
(e) Blast Gauges in turret.
(f) Rabbits in crew positions.

25. Comments on component damage

A Hull floor plate bulged inwards, max. 7 in, total bulged area 72 in x 60 in floor width. Floor plate and welds remained intact without fracture.
B1 Access cover - Oil pump, dislodged outwards - partially held by 2 bolts.
B2 Access cover - Clutch, completely dislodged outwards.
C1) Hull side plates bowed inwards - max. approx. ½ in at floor edge - drawn inwards
C2) and held by bowed floor plate.
D Rear Bulkhead ⅜ in thick buckled.
E1 & E2 Left and Right engine bearers bowed upwards 1 7/16 in and 1⅜ in max. respectively.
E3 & E4 Engine bearer lugs on crankcase right front and rear broken off.
E5 Engine sump shattered.
E6 Engine crankcase sump face crushed and sides cracked.
E7 & E8 Exhaust manifolds fractured and cylinder head fixtures damaged.
F Oil cooler severely bent - no oil leakage.
G1 & G2 Right and Left petrol tanks severely buckled and seams split open - all fuel lost.
H Oil tank severely buckled and seam split open - all oil lost.
I,J & K Clutch, Steering and Gear Change control rods severely bent and put out of adjustment. Right and Left steering rod bell-cranks on gearbox fractured.

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ANTI-TANK TRIALS

Form No. 2

DAMAGE ASSESSMENT DATA (all measurements are in inches)

Trial No. Q 8993
Round No. M.2
Sheet No. .....

(a)	Component (b)	Penetration path: Entry diameter Max. (c)	Entry diameter Min. (d)	Exit diameter Pre-spall Max. (e)	Exit diameter Pre-spall Min. (f)	Exit diameter Spall Max. (g)	Exit diameter Spall Min. (h)	Thick mat. pen. (j)	Location of damage ■ X (k)	Y (l)	Z (m)	Fragment effects No. (n)	Area Length (o)	Area Width (p)	Hole sizes From (q)	Hole sizes To (r)	Penet. depths From (s)	Penet. depths To (t)	Blast (u)	% Loss Fn. (v)	Repair Time (w)	Repair Ech. (x)
A	Hull floor								0	0	0		72	60					X	100		
B1	Access cover - oil pump								0	+ 2	+23		9	9					X	50		
B2	Access cover - clutch								0	+ 2	-25		9	9					X	100		
C1	Hull side plate - Right								+18	-28	0									10		
C2	Hull side plate - Left								+18	+32	0									10		
D	Rear Bulkhead								+ 6	0	+30									10		
E1	Engine Bearer - Left Rail								+ 6	+11	- 2									100		
E2	Engine Bearer - Right Rail								+ 6	- 7	- 2									100		
E3	Engine Bearer R. Front Crankcase Lug								+12	- 7	+13									100		
E4	Engine Bearer R. Rear Crankcase Lug								+12	- 7	-18									100		
E5	Engine Sump								+ 4	+ 2	- 4									100		
E6	Engine Crankcase								+ 5	- 5	0									100		
E7	Engine Exhaust Manifold - Right								+25	-10	- 3									100		
E8	Engine Exhaust Manifold - Left								+25	+14	- 3									100		
F	Oil Cooler								+45	- 4	- 8									10		
G1	Fuel Tank - Right								+ 2	-19	+12									100		
G2	Fuel Tank - Left								+ 2	+23	+ 1									100		
H	Oil Tank								+ 2	-19	-16									100		
I	Control Rod - Clutch								+ 1	-17	0									100		
J1	Control Rods - Steering								+ 1	-12	0									100		
K	Control Rods - Gear Change								+ 1	-15	0									100		
J2	Right Steering Brake Bell Crank								+19	-10	-57									100		
J3	Left Steering Brake Bell Crank								+19	- 4	-57									100		

Note on co-ordinates:

'X' is measured in the Direction of the attack ie vertical and positive up.

'Y' is measured horizontally positive to the right, when looking in the direction of the attack.

'Z' is measured horizontally positive to the front of the vehicle. The origin is taken as the centre of blast zone on the hull floor.

Note: ■ Centre of presented area of each component.

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Report TR.57 Appendix Sheet 2

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Form No. 9

TRIAL NO. 9 8993

F.V.R.D.E. code

ANTI-TANK TRIALS

FIRING RESULTS

Projectile Calibre	Projectile Type
20 lb	Mine A/T Mk.7
TNT	

Round No.	Target tank	Attack azimuth	S.V.	Equivalent range	Stand-off	Armour protection (Normal to armour or in direction of projectile)	O.B.L.	$t\theta$	Residual penetration	Compartment attacked	M	~~K~~ F	~~K~~ K
		degs	ft/s	yds	ins		degs	ins	ins				
M.2	Cent.3 2/62	-	-	-	-	17 mm Thick IT 130 Floor Plate	-	-	-	Engine	100	10	-

Hit location: Centre of blast zone on floor, 2 in right of Horisontal centre line in line with 5th road wheel hub centres.

Profile hole diameter (ins): -

M

Interior Damage

	Component (a)	Jet, frags., blast (b)	% Component loss (c)	% Loss to tank M (d)	% Loss to tank ~~K~~ F (e)	% Loss to tank ~~K~~ K (f)	Location r (g)	Location θ (h)	Repair time (j)
1									m-hrs
2									
3									
4									
5									
6	Rear Bulkhead		10	0			31in	79°	
7	Engine Bearer, Left, Rail		100				13in	62°	
8	Engine Bearer, Right, Rail		100				9in	48°	
9	Engine Bearer, Lug, R. Front (crankcase)		100				19in	51°	
10	Engine Bearer, Lug, R. Rear (crankcase)		100				18in	48°	
11	Engine Sump		100	100			6in	48°	
12	Engine Crankcase		100				7in	44°	
13	Engine Exhaust Manifold - Right		100				27in	22°	
14	Engine Exhaust Manifold - Left		100				29in	31°	
15	Oil Cooler		10				46in	12°	
16	Fuel Tank - Right		100	100			23in	85°	
17	Fuel Tank - Left		100				23in	85°	
18	Oil Tank		100	100			25in	85°	
19	Control Rod - Clutch		100				7in	82°	
20	Control Rod - Steering		100				12in	85°	
21	Control Rod - Gear Change		100	100			15in	86°	
22	Right Steering Brake Bell Crank		100				61in	72°	
23	Left Steering Brake Bell Crank		100				60in	72°	
24	Turret Traverse		10		10				
25	Loss of Power control owing to lost fuel supply to Auxiliary engine.								
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

Exterior Damage

	Component (k)	Jet, frags., blast (l)	% Component loss (m)	% Loss to tank M (n)	% Loss to tank ~~K~~ F (o)	% Loss to tank ~~K~~ K (p)	Repair time (q)
	Hull Floor	B	100	0			m-hrs
	Access Cover - oil pump	B	50	0			
	Access Cover - clutch	B	100	0			
	Hull Side Plate - Right		10	0			
	Hull Side Plate - Left		10	0			

Report TR.57 Appendix Sheet 4

Form No. 1

ANTI TANK TRIALS

DAMAGE ASSESSMENT DATA

(a)	(b)	(a)	(b)
1. Trial No.	Q 8993	13. Projectile azimuth	-
2. Trial location	Foulness Island	14. Projectile elevation	-
3. Date	22/5/62	15. Coded point of attack	Hull Floor
4. Round No.	M.3	16. Location of strike	Centre of blast zone on Long. centre line in line with 3rd road wheel centres.
5. Projectile type	A/T Mine CS Mk.7		
6. Projectile calibre	(20 lb)		
7. Fuze No.	Static Detonation	17. Floor Plate Ground Clearance	20 in
8. Charge weight	-	18. Detail of Mine Laying	Buried 2 in below ground surface with an additional 1½ in soil mound.
9. Striking velocity	-	19	
10. Range:— Gun to target	-	20	
11. Equivalent range with F.S.C.	-	21. Main armour thickness	17 mm Floor Plate
12. Target tank and No.	Cent.3 No.4/62	22. Main armour obliquity	0°
		23. Overall repair time and echelon	-

24. Notes on tank condition prior to firing

1. Right front suspension bracket removed by previous shot attack - support placed under track.
2. Nose ammunition bin damaged by shot attack and was not stowed.
3. Ammunition stowed in floor bins and 4 round ready bin in turret platform.
4. Commander and Gunner represented by Weighted Wooden dummies - instrumented. Driver and Loader represented by unweighted wooden dummies.
5. Blast gauges in turret - Hatches closed.
6. Rabbits in instrumented dummy crew positions.

25. Comments on component damage

A Hull floor plate bulged inwards, max. 4½ in, total bulged area 80 in x 60 in floor width - floor plate and welds remained intact without fracture.
B Rotary Base Junction completely dislodged from floor and forced up 8 in.
C 4 round ready ammo. bin distorted with rounds jammed in their containers.
D Turret turn table platform forced up at centre maximum 8 in - side supports distorted.
E Alternator motor completely dislodged from mounting on Metadyne.
F Division plate 5/16 in thick floor stowage, severely buckled.
G1,G2 & G3 Floor Stowage bins - central rear, left and right inner rear - ammunition and trays ejected into fighting compartment - trays forced up max. 42 in. Bin flaps completely detached from hinges. Ammo. thrown out and damaged.
G4-G9 Floor stowage bins - bin flaps detached and stowed ammunition ejected and damaged.
H1 & H2 Batteries shattered - electrolite and fragments dispersed over whole of the fighting compartment - bin flaps removed.
J Commander's foot rest and column severely bent.
K,L1,L2& M Clutch, Steering and Gear Change Control rods severely bent and out of adjustment. Right steering rod bell crank pivot pin fractured.
N Commander's Dummy - foot damage.
O Gunner's Dummy - right arm off and shoulder broken.
P Loader's Dummy - severe leg and right shoulder damage. Head severe dent.

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ANTI-TANK TRIALS

Form No. 2

DAMAGE ASSESSMENT DATA (all measurements are in inches)

Trial No. Q 8993

Round No. M3

Sheet No. .....

(a)	Component (b)	Penetration path: Entry diameter Max. (c)	Entry diameter Min. (d)	Exit diameter: Pre-spall Max. (e)	Pre-spall Min. (f)	Spall Max. (g)	Spall Min. (h)	Thick mat. pen. (j)	Location of damage ■ X (i)	Y (l)	Z (m)	Fragment effects: No. (n)	Area: Length (o)	Area: Width (p)	Hole sizes: From (q)	Hole sizes: To (r)	Penet. depths: From (s)	Penet. depths: To (t)	Blast (u)	% Loss Fn. (v)	Repair: Time (w)	Repair: Ech. (x)
A	Hull Floor								0	0	0		81	60					X	100		
B	Rotary Base Junction								2	0	0									100		
C	Ammunition Bin - 4Rd. ready								17	-10	0									100		
D	Turret Turntable								17	0	0									100		
E	Alternator Motor								33	0	26									100		
F	Floor Stowage Division Plate								0	0	- 5									100		
G1	Ammunition Bins Floor Stowage Rear Central								0	0	- 23									100		
G2	Right Rear Inner								0	-13	- 23									100		
G3	Left Rear Inner								0	13	- 23									100		
G4	Left Rear Outer								0	24	- 23									100		
G5	Right Rear Outer								0	-24	- 23									100		
G6	Right Front Outer								0	-24	13									100		
G7	Right Front Inner								0	-13	13									100		
G8	Left Front Outer								0	24	13									100		
G9	Left Front Inner								0	13	13									100		
H1	Batteries Front								0	9	35									100		
H2	Batteries Central								0	0	20									100		
J	Foot Rest Commander's								22	-17	- 28									20		
K	Control Rod - Clutch								1	- 9	0									100		
L1	Control Rods - Steering								1	-14	0									100		
L2	Right Steering Brake Ball Crank								19	-12	130									100		
M	Control Rods - Gear Change								1	-17	0									100		
N	Commander - seat position								57	-17	- 34									100		
O	Gunner - seat position								46	-24	0									100		
P	Loader - standing position								12	26	0									100		

See note on Sheet 2

Report TR.57 Appendix Sheet 5

■ **Note:** Centre of presented area of component.

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F.V.R.D.E. code

Projectile Calibre	Projectile Type
20 lb THE	Mine A/T Mk 7

ANTI TANK TRIALS

FIRING RESULTS

Round No.	Target tank	Attack azimuth	S.V.	Equivalent range	Stand-off	Armour protection (Normal to armour or in direction of projectile)	O.B.L.	tθ	Residual penetration	Compartment attacked	M	P	K
	Cent.3	degs	ft/s	yds	ins		degs	ins	ins				
M3	A/62	-	-	-	-	17 mm Thick IT.130 Floor Plate	-	-	-	Turret	100	100	-

Hit location: Centre of blast zone on floor plate on Longitudinal centre line, in line with the 3rd Road Wheel hub centres.

Profile hole diameter (ins): -

F.M.

INTERIOR DAMAGE

	Component (a)	Jet, frags., blast (b)	% Component loss (c)	% Loss to tank M (d)	% Loss to tank P (e)	% Loss to tank K (f)	Location r (g)	Location θ (h)	Repair time (j)
1									m-hrs
2	Rotary Base Junction		100				2 in	0°	
3	Ammunition Bin - 4Rd. ready		100				20 in	32°	
4	Turret Turntable		100				17 in	0°	
5	Alternator Motor		100				42 in	38°	
6	Floor Stowage - Division Plate		100				5 in	90°	
7	Ammunition Bin floor - rear centre		100				23 in	90°	
8	Ammunition Bin floor - right rear inner		100				26 in	90°	
9	Ammunition Bin floor - left rear inner		100				26 in	90°	
10	Ammunition Bin floor - left rear outer		100				33 in	90°	
11	Ammunition Bin floor - right rear outer		100				33 in	90°	
12	Ammunition Bin floor - right front outer		100		100		27 in	90°	
13	Ammunition Bin floor - right front inner		100				18 in	90°	
14	Ammunition Bin floor - left front outer		100				27 in	90°	
15	Ammunition Bin floor - left front inner		100				18 in	90°	
16	Batteries, Front		100				36 in	90°	
17	Batteries, Central		100				20 in	90°	
18	Foot Rest, Commander's		20		0		39 in	56°	
19	Control Rod, Clutch		100	100			9 in	84°	
20	Control Rods, Steering		100	100			14 in	86°	
21	Control Rods, Gear Change		100	100			17 in	87°	
22	Steering brake control bell crank		100	100			132 in	82°	
23	Commander via (seat position)		50				69 in	34°	
24	Gunner via (seat position)		100		95		52 in	28°	
25	Loader via (standing position)		100				29 in	66°	
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

EXTERIOR DAMAGE

	Component (k)	Jet, frags., blast (l)	% Component loss (m)	% Loss to tank M (n)	% Loss to tank P (o)	% Loss to tank K (p)	Repair time (q)
1							m-hrs
2	Hull Floor	B	100	0			

APPENDIX TO
REPORT NO: TR.57
SHEET 7

Measurements of Floor Plate Displacement

Measurements are given at 3 inch interval spacing across the floor plate through the maximum point of bulge starting from the left side edge, facing the front.

Distance from left edge of plate inches		0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
Displacement of floor inches	M2 Target 2/62	0	$1\frac{1}{4}$	$2\frac{1}{4}$	$3\frac{1}{8}$	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$	6	$6\frac{1}{2}$	$6\frac{7}{8}$	7	$6\frac{1}{2}$	$5\frac{7}{8}$	5	$4\frac{1}{4}$	$3\frac{1}{2}$	3	$1\frac{3}{4}$	$\frac{1}{2}$	0
	M3 Target 4/62	0	$\frac{1}{4}$	1	$1\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{5}{8}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	4	$3\frac{7}{8}$	$3\frac{1}{2}$	$3\frac{1}{4}$	$2\frac{3}{4}$	2	$1\frac{1}{8}$	$\frac{1}{4}$	0

FIG. NO.1.

CENTURION TANK TARGET NO.2/62. BEFORE ATTACK M2.

FIG. NO.2.

SHOWING DISTORTION OF THE FLOOR PLATE AFTER ATTACK M2.
MAXIMUM DISPLACEMENT = 7 IN. CHALK LINES INDICATING
CURVATURE 4 IN SPACING.

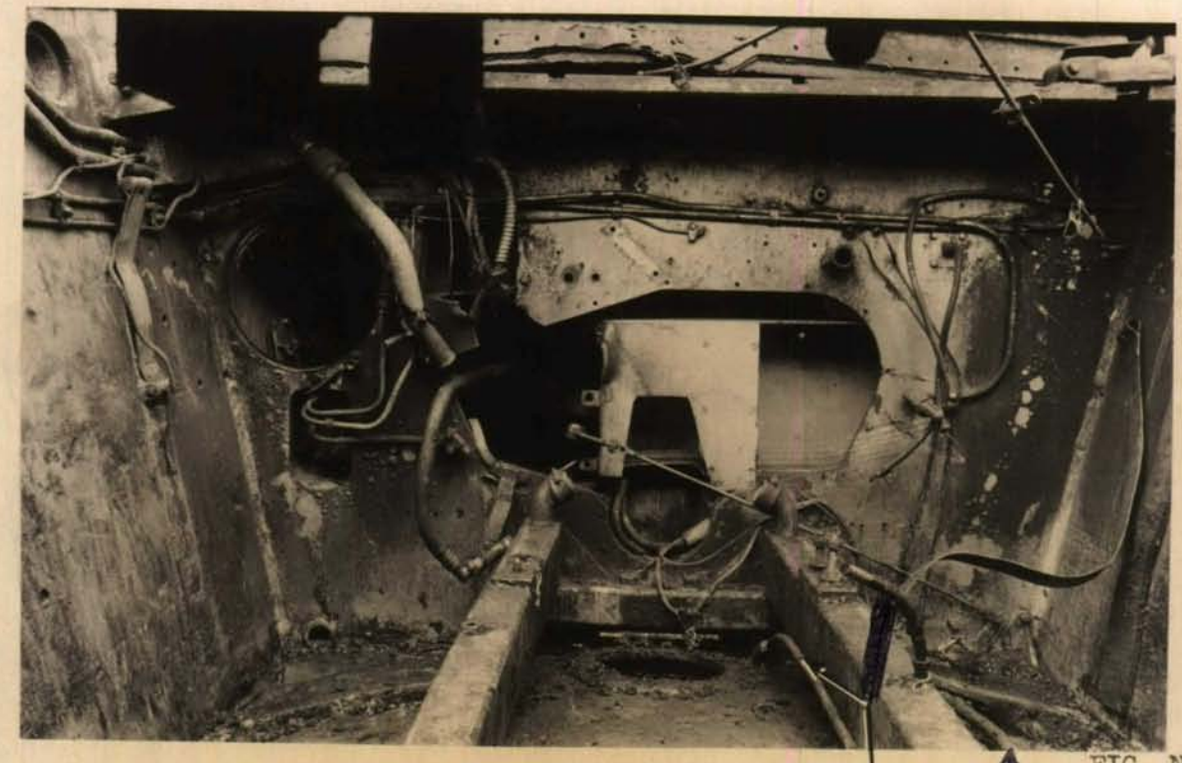

FIG. NO.3.

ATTACK M2. ENGINE COMPARTMENT AFTER ATTACK WITH INTERNAL COMPONENTS REMOVED SHOWING FLOOR DISPLACEMENT AND DISTORTED CONTROL RODS.

FIG. NO.4.

ATTACK M2. SHOWING CONDITION OF CRANKCASE AND SUMP AS FOUND WHEN ENGINE WAS REMOVED.

FIG. NO.5.

ATTACK M2. SHOWING DAMAGE TO FUEL AND ENGINE OIL TANKS.

FIG. NO.6.

CENTURION TANK TARGET NO.4/62
BEFORE ATTACK M3.

REPORT NO. TR. 57

FIG. NO.7.

FIG. NO.8.

VIEWS OF FIGHTING COMPARTMENT FLOOR (AMMUNITION FLOOR STOWAGE FLAPS) PRIOR TO ATTACK M3.

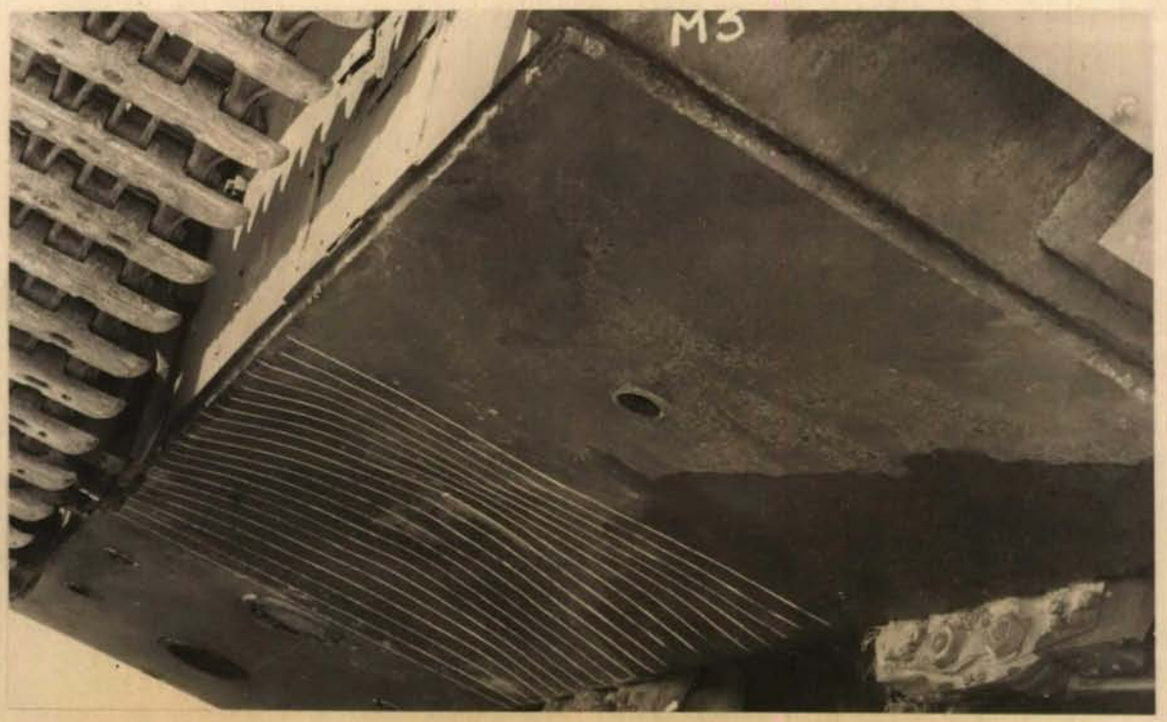

FIG. NO.9.

SHOWING DISTORTION OF FLOOR PLATE AFTER ATTACK M3.
MAXIMUM DISPLACEMENT WAS 4½ IN. CHALK
LINES INDICATING CURVATURE 4 IN SPACING.

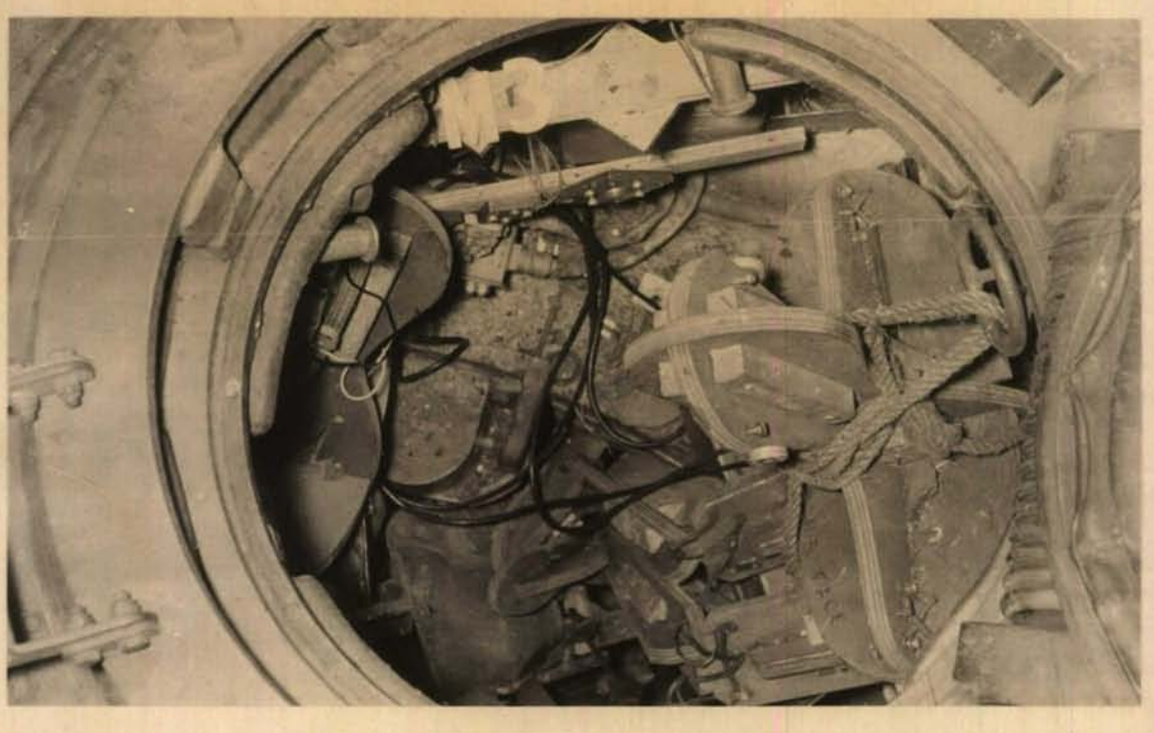

FIG. NO.10.

VIEW THROUGH COMMANDER'S HATCH AFTER ATTACK.

FIG. NO.11.

VIEW THROUGH LOADER'S HATCH AFTER ATTACK M3
SHOWING DAMAGE TO LOADER'S DUMMY AND
DISRUPTED FLOOR STOWAGE.

FIG. NO.12.

ROTARY BASE JUNCTION

SHOWING DISPLACEMENT OF ROTARY BASE JUNCTION PARTLY OBSCURED
BY DISLODGED AMMUNITION TRAY FROM FLOOR STOWAGE BIN ON
ATTACK M3.

FIG. NO.13.

ATTACK M3. SHOWING DISRUPTED AMMUNITION FLOOR STOWAGE BINS.

FIG. NO.14.

ATTACK M3. SHOWING DAMAGE TO AMMUNITION STOWED IN THE FLOOR BINS.